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$$\sin(\phi+\frac{\theta}{2}).\{\cos^2(\phi+\frac{\theta}{2})+\sec^2\frac{\theta}{2}\}=0,$$

whence $\phi=-\frac{\theta}{2}$.

That is, the medial line is horizontal. The second factor gives imaginary results, except when $\theta=0$.

PROBLEMS.

39. **Proposed by B. F. FINKEL, A. M., Professor of Mathematics and Physics in Drury College, Springfield, Missouri.**

A person whose height is a and weight W stands in a swing whose length is l. Supposing the initial inclination of the swing to the vertical is α and that the person always crouches when in the highest position and stands up when in the lowest, his center of gravity moving through a distance b measured from lower part of swing upward, find how much the arc is increased after n complete vibrations.

40. **Proposed by F. P. MATZ, Sc. D., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.**

Find the law of the force, in order that the orbit may be a Cassinian Oval.

41. **Proposed by O. W. ANTHONY, M. Sc., Professor of Mathematics and Astronomy, New Windsor College, New Windsor, Maryland.**

If the earth were a perfect sphere and had a frictionless surface, what would be the motion of a ball placed at a given latitude?

DIOPHANTINE ANALYSIS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

40. **Proposed by F. P. MATZ, D. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.**

The sum of three positive integral *cubic* roots of an equation is a square. What is the equation?

I. **Solution by E. L. SHERWOOD, A. M., Professor of Mathematics and Science in Mississippi Normal College, Houston, Mississippi.**

Let a, b, and c be the roots of the equation.

We then have $a^3+b^3+c^3=\square$.

This condition is satisfied by the equation $v^4(v^2+8v^2+27v^2)=\square$, where

$a^3=v^6$, $b^3=8v^6$ and $c^3=27v^6$. Forming the equation from the roots, we have: $x^3-(a^3+b^3+c^3)x^2+(a^3b^3+a^3c^3+b^3c^3)x-a^3b^3c^3=0$.

Substituting values of a, b, c and reducing, we have:

$x^3-36v^6x^2+251v^{12}x-216v^{18}=0$, where "$v$" may be 1, 2, 3, etc., in succession.

II. Solution by A. H. HOLMES, Brunswick, Maine, and G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics in Texarkana College, Texarkana, Arkansas-Texas.

Let a, b, c be the roots of the cubic equation.

$\therefore$ $x^3-(a+b+c)x^2+(ab+ac+bc)x=abc$, is the equation.

Let $a=5m^2$, $b=3m^2$, $c=m^2$. $\therefore$ $5m^2+3m^2+m=9m^2$.

$\therefore$ $x^3-9m^2x^2+23m^4x=15m^6$ ....(1).

Let $a=m^2+mn$, $b=n^2-mn$, $c=2mn$, $m>n$.

$\therefore$ $m^2+mn+n^2-mn+2mn=(m+n)^2$.

$\therefore$ $x^3-(m+n)^2x^2+(3m^3n+3mn^3)x=2m^4n^2-2m^2n^4$ ....(2).

(1) and (2) both satisfy the conditions.

41. Proposed by H. C. WILKES, Skull Run, West Virginia.

Given $\dfrac{50(a+b)}{ab}=\dfrac{81(c+d)}{cd}$......(1); $\dfrac{56(a+c)}{ac}=\dfrac{75(b+d)}{bd}$......(2);

$\dfrac{65(b+c)}{bc}=\dfrac{66(a+d)}{ad}$......(3), to find the least integral values of a, b, c, d.

I. Solution by the PROPOSER.

The sum of equations (1), (2) and (3), after clearing of fractions, can be reduced to $20d(ab+ac+bc)=111abc$......(4).

Eliminating from (1) and (4), $6d=9c$.

Eliminating from (2) and (4), $5d=9b$.

Eliminating from (3) and (4), $4d=9a$.

$\therefore$ The numbers are in the ratio $a4$, $b5$, $c6$, $d9$, which will be the least integers that will satisfy the equation. [See problem No. 36.]

II. Solution by A. H. BELL, Hillsboro, Illinois.

Arranging, $50acd+50bcd=81abc+81abd$. (1).

$75acd+56bcd=-75abc+56abd$. (2).

$65acd-66bcd=66abc-65abd$. (3).

$(1)\times3$ $150acd+150bcd=243abc+243abd$. (4).

$(2)\times2$ $150acd-112bcd=-150abc+112abd$. (5).

$(4)-(5)$ $262bcd=393abc+131abd$. (6).

$(2)\times13$ $975acd-728bcd=-975abc+728abd$. (7).

$(3)\times15$ $975acd-990bcd=990abc-975abd$. (8).

$(7)-(8)$ $262bcd=-1965abc+1703abd$. (9).

$(9)-(6)$, and reducing $3c=2d$. $\therefore$ $c=2$, and $d=3$ (10).

These values in (1) and (2), etc., $a=4$ and $b=5$ (11).